Scaffolding effective help-seeking behaviour in mastery and performance oriented learners

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Abstract. In order to build learning systems that care we need to increase our understanding of the affective and motivational dimensions of learning. This will allow us to develop a model of our learners which extends beyond their behaviours to the feelings and motivations which underlie those behaviours. In this paper we focus on children’s (10 yrs) help-seeking behaviour when using an interactive learning environment (ILE) called Ecolab II. We relate help-seeking strategies to achievement goal orientation (AGO) by constructing detailed child profiles and directly observing behaviour.

Keywords. Mastery and performance goals, help-seeking

1. Introduction

In recent years ILEs have developed beyond purely cognitive modelling towards also modelling learners’ metacognitive and affective behaviour [1, 2, 3]. Progress has been made in systems’ capabilities to detect and diagnose metacognitive and affective dimensions of learning [4] but we are still faced with significant challenges in tutoring or scaffolding students’ behaviour at this level [5]. In particular the effectiveness of metacognitive scaffolding depends on how students respond to and use such help, which varies a great deal between students [3]. Enabling a system to adapt to such variability involves increasing our understanding of the individual differences that determine these important learning behaviours. In particular, we argue this involves developing a model of the learner which extends beyond specific learning behaviours towards the motivations which underlie them.

Help-seeking

In this paper we focus on help-seeking as a critical metacognitive ability. The process of help-seeking involves the learner recognising a difficulty or error and employing an appropriate strategy to overcome the problem detected. Seeking help appropriately is an adaptive strategy for learning which promotes task mastery and comprehension [6].

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However, students’ behaviour and motivation varies a great deal in relation to help seeking processes [1]. For example, some students do not always request help when it would be most useful while others consistently seek help even though they are able to understand a task independently. Students vary too in the type of help they ask for and a distinction has been made between instrumental and executive help [7]. Instrumental help involves using methods which clarify and support understanding, such as helpful hints or clues, leading to independent task mastery. Executive help involves seeking solutions, such as requesting the answer directly, which leads to task completion but without necessarily increasing comprehension. The type of help children seek is influenced by their approach to learning and their achievement goals.

**Achievement Goals.**

Achievement goal theory [8, 9] offers a useful framework for understanding individual differences in students’ beliefs, attitudes and feelings about learning in general and toward success and failure in particular. In classroom and laboratory studies goal orientation has been an important influence on metacognitive processes, such as help-seeking [10]. Goal theory identifies two broad approaches or orientations towards learning. Students who are focused on understanding new material, mastering skills and developing competence are said to hold mastery goals: learning and improvement are assessed using self-referenced standards where the quality of one’s work is judged relative to one’s previous achievement. Mastery goals are associated with the use of effective learning strategies and deep-level learning [8]. For example, mastery-motivated children tend to expend more effort, are more persistent, show a preference for challenging tasks and use instrumental help-seeking strategies [6]. In contrast, learners who are focused on demonstrating their knowledge and gaining favourable judgements of ability are said to hold performance goals: learning is judged by how well one is performing relative to others and involves social comparisons [9]. With a greater concern for evaluation of performance by others, help-seeking tends to be viewed as an indication of low ability within this orientation. Performance-motivated children tend to show a preference for tasks they feel they can complete without challenge and if they do seek help, they tend to choose executive help. In general, performance goals are associated with less effective strategies and consequently surface-level learning [9].

Interactive learning environments offer the possibility of dynamically adapting feedback and scaffolding according to achievement goal orientation as well as encouraging children to adopt the most appropriate type of goal for the context. Mindful of the difficulties in applying achievement goal theory to specific learning contexts [11], we use an existing ILE, Ecolab II, to investigate the role of achievement goal orientation in children’s help-seeking behaviour and the possibilities of software to respond dynamically to this important influence on learning.

**Ecolab II.**

Ecolab II is an ILE designed to help children learn about food chains and food webs [3]. This area of Ecology forms part of the Key Stage 2 (9 - 11 years old) UK National Science Curriculum. The system has a learner model and a scaffolding structure that
can detect and respond to learners at both a domain and a metacognitive level. At the
domain level the child can select help at one of four levels of specificity; clue levels
were developed using Wood, Bruner and Ross’ levels of scaffolding as a guide [12].
Scaffolding at the metacognitive level involves guidance for help-seeking strategies.
For example, when a child needs help at the domain level but is not using the help
facility appropriately, the system responds by providing meta-help at one of three
levels of specificity. First, the child will be reminded that help is available (Level 1:
Don’t forget that you can ask Ecolab for help). Second, if the child consistently selects
cues at a low level but is not progressing the system will prompt them to select a
higher level clue. Similarly if the child consistently selects high level clues and is
successful the system will prompt the child to select a lower level clue next time they
need help (Level 2: Why not ask Ecolab for more/less help). Finally, if the child does
not respond to Levels 1 and 2 the system will suggest a specific level to the child
depending on their performance (Level 3: Try level X help (e.g. Clue 4)).

Previous evaluations of Ecolab II have shown it to be effective in promoting
learning, particularly for low-ability children with poor metacognitive skills [3].
However, learning gains are dependent on children using system help appropriately and
not all children respond to metacognitive scaffolding in the same way: some show little
change in help-seeking behaviour or improvement in understanding. We believe that
goal orientation may account for some of these differences by influencing children’s
receptivity to metacognitive assistance. If this is the case, then goal orientation would
be a crucial variable to consider when constructing a model of the learner, particularly
in understanding help-seeking but also metacognitive abilities more generally.

The Current Study

In the current study we explore the extent to which mastery and performance goals
influence learners’ help-seeking behaviours when using Ecolab II. Previous work has
highlighted the importance of observing behaviour and the context in which it occurs in
order to assess accurately the role that mastery and performance goals play in learning
[13]. We therefore began our study by constructing detailed learner profiles in relation
to achievement goal orientation and help-seeking behaviour before observing
children’s interactions with Ecolab II.

2. Method

Participants and design

Participants were 35 (19 males and 16 females) Year 5 children (10 years old)
attending a village primary school in the South of England. Each child participated in
two individual sessions about a week apart. The first session assessed children’s help-
seeking behaviour and achievement goal orientation in order to develop learner profiles.
In the second session children used Ecolab II for about 30 minutes either individually
or in pairs. After 10 minutes of familiarisation with the software children were given
an explicit task: to make two different food chains which had one organism common to
both. For the age of our sample this was a deliberately challenging task as we wanted to ensure children would need some assistance.

**Measures**

2.1. Learner profiles

In order to construct detailed learner profiles of children’s achievement goal orientation we conducted semi-structured interviews with each child individually. All interviews were audio recorded for later transcription and analysis.

- **Help-seeking behaviour**: We asked children a set list of questions about when and how they asked for help in class, where they tended to look for help both at school and at home and how they felt about asking for help in different learning contexts. The questions were used to stimulate discussion about each child’s help-seeking behaviour and were adapted from previous work [3]. Where children struggled to reflect on or articulate their experience we presented them with a range of possible responses from which they could choose.

- **Achievement goal scenarios**: Building on previous work which has used scenarios to measure achievement goal orientation [13] we presented children with two hypothetical characters whose descriptions matched mastery- or performance-oriented patterns of behaviour (Figure 1a and 1b). Using a storyboarding programme called Kar2ouche we were able to create a classroom scenario in which to place the characters. The characters were gender balanced; boys were presented with male characters and girls presented with female characters. After listening to the characters descriptions our participants were ask to predict the character’s behaviour during two subsequent learning tasks and then asked to select which of the characters were most like them. We choose a third person approach in attempt to balance the social desirability bias often evident when children are asked directly to choose between mastery or performance goals [14]. Talking on behalf of a third person character allowed the children to express their views more freely and provide relatively unbiased accounts of their achievement oriented behaviours and goal preferences.

![Figure 1a. Mastery Description.](image1)

![Figure 1b. Performance description.](image2)
2.2. Help-seeking using Ecolab II

Using system logs we measured the type of help children used during their interaction with Ecolab II and whether that help was effective in helping them move forward with the task. There are two options for getting help while using Ecolab II: clues or views. A clue is presented automatically after an error is made. Children can then choose the type of clue they want; clues range from level one (least specific) to level four (most specific). We calculated how many times children selected lower end clues (levels 1 and 2) and higher end clues (levels 3 and 4). We also measured whether children tried to use the clues they were given by attempting further actions or whether they gave up on the task and move on to something new after receiving the clue.

As well as receiving clues children could also move freely between three different types of representations or views. While switching views is not essential to the task doing so can provide additional help as each view offers a different form of information about the ecology system. World view shows which organisms eat and are eaten by other organisms; web view shows the hierarchies of organisms and within them separate food chains and energy view shows how an organism’s energy changes when it eats or is eaten by another organism. For the specific task given to the children in this study, the web view was the most effective way of seeing different food chains and the energy view was the least useful for this task.

3. Results

Learner profiles

Our method of assessing children’s achievement goal orientation enabled us to create rich profiles of each learner. These were used to identify patterns of behaviour outlined in theory [9, 14] which indicate a child’s dominant achievement goal orientation. It became evident during our analysis of the learner profiles that only addressing specific behaviours, such as help avoidance, was too simplistic an approach as the reasons children gave for their behaviour indicated much more complex and varied motivations. For example, the three children below all indicated they would not ask for help even if they were struggling which on the surface indicates they are help avoidant and therefore likely to be performance oriented. However, closer analysis of their reasoning suggest three distinct goal orientations:

Child A: “I know the teachers are there for you and they can help you but I do feel a bit silly with the kids around.”

Child B: “I don’t like asking her [the teacher] for help because I like doing things by myself to show that I am clever”

Child C: “When you ask a maths question I don’t think they should ever give the answer because it doesn’t help learning at all”

While Child A avoids asking for help so as not to appear silly in front of peers (performance-avoidant), Child B does so in order to demonstrate his cleverness (performance-approach) and Child C does so in order to learn more about the task itself (mastery). Although we were often able to distinguish between performance-avoidant and performance-approach behaviours, as in this example, this was not always the case.
and we have categorized children using a dichotomous mastery performance split in line with previous work [8, 13].

Using the transcripts of the semi-structured interviews in this way, we found that 27 children reported very clear and consistent patterns of behaviour. We were reliably able to identify 13 (7 male, 6 female) as mastery oriented and 14 (9 male, 5 female) as performance oriented by matching their reports to behavioural profiles outlined in previous literature [9, 10, 13, 14]. The remaining 8 children (3 male, 5 female) presented mixed profiles, sometimes reporting mastery-motivated behaviour and sometimes reporting performance-motivated behaviour. As we were not sure of how to classify them prior to their Ecolab session we excluded them from the current analysis.

**Help seeking using Ecolab II**

First we looked at differences between mastery and performance groups in their preference for clues at different levels of specificity. The means and standard deviations shown in the first two columns of Table 1 show no difference between groups in the number of times they chose lower level clues. However, while highly variable, performance-oriented children tended to select clues at the higher end of the scale more frequently than their mastery-oriented counterparts. It is interesting to note that while all children used clues at the lower end of the scale relatively often, mastery-oriented children rarely selected a clue at the higher end of the scale.

Higher end clues offered a generic example which children then had to generalise to the specific food chain they were working on. For example, Clue level 4 “stickleback eats tadpole and is eaten by heron” presents the correct format for entering a successful answer, even though these may not be the specific organisms in the child’s world. We found that mastery children were better able to generalise these generic clues to their own food chains, for example, vole eats blackberries and is eaten by grass snake. On the other hand, performance-oriented children seemed less able to do this and tended to repeat their earlier mistakes. They were also significantly more likely to move on to another problem if the clue had not helped them immediately (F(1, 17) = 4.8, p = 0.04). This usually involved a less challenging action such as linking two organisms rather than three organisms.

Another resource available to children was the ability to switch between the different views available. The means and standard deviations in the last three columns of Table 1 represent the frequency of children’s use of each of the three views. Mastery-oriented children clicked between world and web view more often and made significantly more use of the web view than the performance-oriented children (F(1, 17) = 8.05, p = 0.01). Although not significant it is interesting to note that performance-oriented children made more use of the energy view, which was the least helpful.

<table>
<thead>
<tr>
<th>Table 1. Means (standard deviations) of types of help</th>
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<td>Low end clues</td>
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4. Discussion

The differences observed in this study between mastery- and performance-oriented children’s help-seeking behaviour using Ecolab II has highlighted the importance of considering this motivational dimension when supporting children’s learning. We have highlighted specific behaviours, elicited through child profiles and direct observation of behaviour during Ecolab sessions which indicate important behavioural differences between those children who adopt mastery goals and those who adopt performance goals. Particularly we found that mastery-oriented children very rarely selected high level clues but rather preferred clues which provided helpful hints without giving them the whole or part of the answer. In addition, these children made more use of the different resources available to them in seeking help on the task, for example, using the web view. This was a very effective way of receiving additional help but had not been explicitly communicated to the children. Mastery-oriented children therefore appeared to have more strategies in their repertoire for getting help than the performance-oriented children. The latter were more likely to select clues which gave them either the whole or part of the answer and tended to move on quickly to other less challenging problems if the clues were not immediately useful. These behavioural profiles are consistent with theory indicating that mastery children tend towards instrumental help while performance children tend towards executive help [10].

In addition we have shown that performance-oriented children do not necessarily use the help they are given in an effective way. For example, even when high level, executive clues were chosen, performance-oriented children had great difficulty in transferring the strategy given in the clue to the particular problem they were working on. Progress therefore stalled after an error was made regardless of help provision. This was not the case with mastery-oriented children who used lower level clues and also made good use of other resources such as different views in working out the relationships between organisms. These results suggest that progress may be limited for a performance-oriented child, not necessarily by a lack of clear help-seeking strategies, but rather by an inability to transfer those strategies into correct choices. This highlights the important gap between having a specific piece of knowledge and using and applying it appropriately [4]. Our results suggest that performance-oriented children may lag behind their mastery counterparts in this aspect of metacognition.

These results point to important differences in help-seeking behaviour between mastery and performance oriented children when using an ILE. However, a limitation of the study was that we did not control for children’s initial level of domain knowledge. This could have been a confounding variable impacting both goal orientation and help-seeking behaviour. A larger study is planned which will address the relationship between domain knowledge, help-seeking behaviour and achievement goal orientation.

The next step is for a system to use knowledge of goal orientation to guide learners towards more effective help-seeking behaviour. We are currently adapting Ecolab II to incorporate aspects of achievement goal orientation into its learner model and are designing a level of scaffolding aimed at encouraging the adoption of the most adaptive achievement goals for the specific context. For example, when the system detects the child needs help at the domain level and the objective is to encourage more appropriate use of help and the interaction suggests the participant is behaving in a performance oriented way, then the wording of the meta-help might be varied in order to appeal to a performance orientation, for example, by emphasising social comparison and the correct solution:
1. Level 1: Learners just like you ask Ecolab for help
2. Level 2: Other learners ask Ecolab for more/less help here
3. Level 3: Level X help (e.g., level 3) will help you find the answer

As the learner improves at domain-level help-seeking, this text might be replaced with a more mastery-oriented version. This would foster an increasingly adaptive learning approach, encouraging the child to be more persistent and effective in using the help on offer. This approach introduces an additional level of fading (goal orientation). For example, by emphasising understanding, a learner might be encouraged toward mastery goals as previous work suggests [12]:

1. Level 1: To understand more about food chains ask Ecolab for help Level 2:
2. Level 2: Some more/less help might improve your understanding
3. Level 3: Level X help (e.g. Level 3) will help you work out the answer

Exploring achievement goal orientation as a new dimension to metacognitive scaffolding extends the qualities of the learner that can be model within a system. This method has the potential to be the first that matches personal goals (detected through the learner model) with contextual goals (provided by the software scaffolding) in a dynamic manner.

References